



Home Energy Savings Impact Evaluation Report

Energy Efficiency Plan: Plan Year 6 (PY6)
(6/1/2016-12/31/2017)

Presented to
Nicor Gas Company

Final

June 8, 2018

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1. INTRODUCTION

This report presents the results of the impact evaluation of the Nicor Gas PY6 Home Energy Savings (HES) Program. It presents a summary of the energy impacts for the total program and broken out by relevant measure and program structure details. The appendix presents the impact analysis methodology. PY6 covers June 1, 2016 through December 31, 2017.

2. PROGRAM DESCRIPTION

The HES Program includes an assessment and direct install component jointly implemented by Nicor Gas and Commonwealth Edison (ComEd) with CLEAResult leading the program implementation, and a rebate component for air sealing, insulation and duct sealing work completed by approved contractors. This report focuses on natural gas savings achieved by Nicor Gas program participants. Savings from electric measures are included in a separate evaluation report delivered to ComEd.

The HES Program provides a free home energy assessment performed by an energySMART energy advisor (energy advisor). The energy advisor collects information about the home's energy use by examining the heating system (e.g. furnace or boiler), cooling system (air conditioner), water heater, and attic (if accessible). The energy advisor provides a customized report with recommendations identifying additional ways the customer can save energy and money. As part of the energy assessment and when appropriate, the energy advisor installs or sets direct installation (DI) measures. These DI measures include showerheads, faucet aerators for bathrooms and kitchen, and hot water pipe insulation; installs and/or sets a programmable or smart thermostat; and sets back the water heater temperature. In addition to the free home energy assessment and free direct install measures, the HES Program also offers rebates for air sealing, duct sealing, and building shell insulation (ASI) measures for eligible homes installed by an energySMART-approved contractor. Measures include air sealing, attic insulation, duct sealing, basement sidewall, and wall insulation. Air sealing includes sealing gaps and cracks in the wall where air can get in and out. The contractor performs a blower door test to measure the air leakage in the home. Participants must have air sealing and attic insulation installed at the same time in order to receive the rebate.

The program had 8,583 participants in PY6 and completed 8,821 projects as shown in the following table.

Table 2-1. PY6 Volumetric Summary

Participation	ASI	DI	Total*
Participants †	1,298	7,449	8,583
Installed Projects ‡	1,311	7,549	8,821

Source: Nicor Gas tracking data and Navigant team analysis.

† Participants are defined as unique site contact addresses

‡ Installed Projects are defined as unique Vendor Project IDs

*Totals do not sum as there is an overlap between participants that received ASI and DI measures.

Table 2-2 summarizes the installed measure quantities that are the basis for verified energy savings.

Table 2-2. PY6 Installed Measure Quantities

Measure	Quantity Unit	Installed Quantity
Duct Sealing	Home	29
Air Sealing	Home	1,245
Basement/Sidewall Insulation	Square Feet	21,549
Attic Insulation	Square Feet	1,547,560
Wall Insulation	Square Feet	73,452
Programmable Thermostat	Each	1,213
Thermostat Education	Each	990
Smart Thermostat (Manual Baseline)	Each	226
Smart Thermostat (Programmable Baseline)	Each	900
Smart Thermostat (Unknown Baseline)	Each	31
Hot Water (HW) Pipe Insulation	Linear Feet	9,009
Bathroom Aerator	Each	8,589
Kitchen Aerator	Each	1,665
Showerhead	Each	8,186
Water Heater Setback	Each	1,296

Source: Nicor Gas tracking data and Navigant team analysis.

3. PROGRAM SAVINGS SUMMARY

Table 3-1 summarizes the energy savings the HES Program achieved by path in PY6.

Table 3-1. PY6 Annual Energy Savings Summary

Program Path	Ex Ante Gross Savings (Therms)	Verified Gross RR†	Verified Gross Savings	NTGR‡	Verified Net Savings (Therms)
ASI	253,141	100%	252,925	1.05	265,571
DI	341,161	100%	340,813	1.05/NA§	354,518
Total*	594,302	100%	593,738		620,090

Source: Nicor Gas tracking data and Navigant team analysis.

† Realization Rate (RR) is the ratio of verified gross savings to ex ante gross savings, based on evaluation research findings.

‡ Net-to-Gross Ratio (NTGR) is the ratio of verified net savings to verified gross savings. The NTGR is a deemed value.

Source: Nicor_Gas_GPY6_NTG_Values_2016-02-29_Final.xlsx, which is to be found on the Illinois SAG web site:

<http://ilsag.info/net-to-gross-framework.html>.

§ The IL TRM algorithm for smart thermostat savings calculates net savings, so the 1.05 NTG value applied to other measures installed through this program path was not applied to smart thermostat gross savings.

* Program Path savings values may not add up to Total due to rounding

4. PROGRAM SAVINGS BY MEASURE

The program includes 15 measure types as shown in the following table. Air sealing, showerheads, attic insulation, and programmable thermostats contributed the most savings at 21, 19, 17, and 12 percent of program savings respectively.

Table 4-1. PY6 Annual Energy Savings by Measure

Measure Types	Ex Ante Gross Savings (Therms)	Verified Gross RR†	Verified Gross Savings (Therms)	NTGR‡	Verified Net Savings (Therms)
Duct Sealing	14,077	96%	13,462	1.05	14,135
Air Sealing	127,371	100%	127,243	1.05	133,605
Basement/Sidewall Insulation	3,437	109%	3,746	1.05	3,934
Attic Insulation	100,445	100%	100,663	1.05	105,696
Wall Insulation	7,810	100%	7,810	1.05	8,201
Programmable Thermostat	71,336	100%	71,098	1.05	74,653
Thermostat Education	58,758	100%	58,758	1.05	61,696
Smart Thermostat (Manual Baseline)	17,814	104%	18,593	NA§	18,593
Smart Thermostat (Programmable Baseline)	46,681	98%	45,795	NA§	45,795
Smart Thermostat (Unknown Baseline)	2,305	100%	2,305	NA§	2,305
HW Pipe Insulation	9,549	100%	9,522	1.05	9,998
Bathroom Aerator	5,926	100%	5,926	1.05	6,223
Kitchen Aerator	9,324	100%	9,324	1.05	9,790
Showerhead	114,931	100%	114,959	1.05	120,707
Water Heater Setback	4,536	100%	4,532	1.05	4,758
Total*	594,302	100%	593,738		620,090

Source: Nicor Gas tracking data and Navigant team analysis.

† Realization Rate (RR) is the ratio of verified gross to ex ante gross savings, based on evaluation research findings.

‡ Net-to-Gross Ratio (NTGR) is the ratio of verified net savings to verified gross savings. The NTGR is a deemed value. Source: Nicor_Gas_GPY6_NTG_Values_2016-02-29_Final.xlsx, which is to be found on the Illinois SAG web site: <http://ilsag.info/net-to-gross-framework.html>.

§ The IL TRM algorithm for smart thermostat savings calculates net savings.

* Measure-level savings values do not add up to Total due to rounding.

5. IMPACT ANALYSIS FINDINGS AND RECOMMENDATIONS

5.1 Impact Parameter Estimates

Table 5-1 shows the unit therm savings and realization rate findings by measure from our review. The realization rate is the ratio of the verified savings to the ex ante savings. Following the table, we provide findings and recommendations, including discussion of all measures with realization rates above or below 100 percent. Appendix 1 provides a description of the impact analysis methodology.

Table 5-1. Verified Gross Savings Parameters

Measure	Unit Basis	Ex Ante Gross (therms/unit) †	Verified Gross (therms/unit) †	Realization Rate	Data Source(s)*
Duct Sealing	Home	485.42	464.21	96%	IL TRM v5.0, Section 5.3.4
Air Sealing	Home	102.31	102.20	100%	IL TRM v5.0, Section 5.6.1
Basement/Sidewall Insulation	Square Feet	0.25	0.27	109%	IL TRM v5.0, Section 5.6.2
Attic Insulation	Square Feet	0.07	0.07	100%	IL TRM v5.0, Section 5.6.4
Wall Insulation	Square Feet	0.11	0.11	100%	IL TRM v5.0, Section 5.6.4
Programmable Thermostat	Each	Varies	Varies	100%	IL TRM v5.0, Section 5.3.11
Thermostat Education	Each	Varies	Varies	100%	IL TRM v5.0, Section 5.3.11
Smart Thermostat (Manual Baseline)	Each	81.67	88.54	104%	IL TRM v5.0, Section 5.3.16
Smart Thermostat (Programmable Baseline)	Each	Varies	Varies	98%	IL TRM v5.0, Section 5.3.16
Smart Thermostat (Unknown Baseline)	Each	74.35	74.37	100%	IL TRM v5.0, Section 5.3.16
HW Pipe Insulation	Linear Feet	1.06	1.06	100%	IL TRM v5.0, Section 5.4.1
Bathroom Aerator	Each	0.69	0.69	100%	IL TRM v5.0, Section 5.4.4
Kitchen Aerator	Each	5.6	5.6	100%	IL TRM v5.0, Section 5.4.4
Showerhead	Each	14.04	14.04	100%	IL TRM v5.0, Section 5.4.5
Water Heater Setback	Each	3.5	3.5	100%	IL TRM v5.0, Section 5.4.6

* State of Illinois Technical Reference Manual version 5.0 from <http://www.ilsag.info/technical-reference-manual.html>.

† Per unit savings for duct sealing, air sealing, building shell insulation, and thermostat measures are project specific. The per unit savings values shown for these measures are averages across all participants.

5.1.1 Duct Sealing

Duct sealing had a gross energy savings realization rate of 96 percent. Navigant was able to calculate 100 percent realization rates for 62 percent of duct sealing projects. However, Navigant calculated realization rates of 69 percent, 92 percent, and 102 percent for the remaining 38 percent of projects using the same method and available data. Following Navigant’s mid-year interim review¹, the implementer informed Navigant that the cause of the discrepancy was an issue with their calculation of Pre-Duct

¹ Memo from Charles Ampong, Jennifer Ma, and Christine Zook, *Nicor Gas GPY6 Home Energy Savings Program Tracking Database and Savings Interim Review*, October 17, 2017. Sent by Kevin Grabner via email.

Sealing Heating System Efficiency = Equipment Efficiency * Pre-Distribution Efficiency. They have corrected the issue for future program years but did not make any corrections retrospectively.

Recommendation 1. Navigant recommends using the formula $\eta_{\text{System}} = DE_{\text{before}} * \eta_{\text{Equipment}}$ to calculate η_{System} for duct sealing.

5.1.2 Basement/Sidewall Insulation

Basement/sidewall insulation had a gross energy savings realization rate of 109 percent. Navigant found discrepancies between verified and ex ante gross savings for 18 percent of basement/sidewall measures due to insulation post-install and heating degree day (HDD) inputs. In Vendor Project ID's PRJ-1441007 and PRJ-1441431, the implementer's tracking data listed insulation post-install R-values of 21 but the implementer calculated ex ante savings using lower post-install R-values. Secondly, Navigant and the implementer used different HDD values, which change if a home's basement is air conditioned or not air conditioned. For the remaining projects with evaluation adjustments, the implementer calculated savings using unconditioned HDD values despite the tracking data showing that the home had central air conditioning. Navigant used conditioned HDD values if the project's cooling system type was "Central Air Conditioning" and unconditioned HDD values if there was no cooling system type.

Recommendation 2. Navigant recommends the implementer use unconditioned HDD values if a home does not have central air conditioning and conditioned HDD values if a home has central air conditioning.

5.1.3 Attic Insulation

Attic insulation had a gross energy savings realization rate of 100 percent. For three percent of projects, Navigant estimated realization rates above 100 percent. For these projects, the program installed insulation with R-values above 49 but gave no more incentive to the customer for R-values above 49 and the implementer calculated savings using $R = 49$. Navigant, Nicor Gas, and the implementer agreed that although the program caps incentives, the program should not cap savings at $R = 49$. Navigant calculated savings with the actual R-value above 49. The implementer has informed Navigant they will calculate savings with the actual R-value above 49 in future programming years. The implementer did not make any corrections retrospectively.

Recommendation 3. For projects with installed insulation R-value above 49, Navigant recommends calculating savings with the actual R-value above 49.

5.1.4 HW Pipe Insulation

Hot water pipe insulation had a gross energy savings realization rate of 100 percent. The implementer informed Navigant that the actual R-value for pipe insulation installed was 3.8 for all projects. Navigant calculated verified savings using $R = 3.8$ for all projects but found that the "Post Install Value" field reflected $R = 3.8$ for less than four percent of projects – those for December 31, 2017.

Recommendation 4. Navigant recommends the implementer ensure that the "Post Install Value" field accurately reflects the R value of pipe insulation installed for each project.

5.1.5 Thermostats

There are five thermostat measures depending on thermostat and installation type offered in this program, Programmable Thermostat – DI, Programmable Education, Smart Thermostat – Manual Baseline, Smart Thermostat – Programmable Baseline, and Smart Thermostat – Unknown Baseline. These measures have gross energy savings realization rates of 100, 100, 104, 98, and 100 percent, respectively.

Navigant identified four inconsistencies in the thermostat ex ante savings calculations. These were related to installed quantities, climate zone designation, inconsistent residential building type, or wrong assumption of installed thermostat type or baseline. Table 5-2 below lists these discrepancies.

Table 5-2. Discrepancies from Thermostat Ex Ante Savings

Measure	Example Project IDs	No. of Projects with Discrepancy	Discrepancy
Programmable Thermostat	PRJ-1679267, PRJ-16279782, plus others	4	Capped quantity of savings to 1 for single family homes
Programmable Thermostat	PRJ-1210899, PRJ-1210904, PRJ-1226080, plus others	8	Ex ante savings based on climate zone different than site's climate zone
Smart Thermostat (Programmable Baseline)	EA-0000139191, EA-0000291025, plus others	50	Ex ante savings assumed manual baseline but tracking data measure name showed programmable baseline
Smart Thermostat (Programmable Baseline)	PRJ-1090180, PRJ-1254739, PRJ-1262337, plus others	39	Ex ante savings assumed prescriptive install programmable thermostat in climate zone 1 but tracking data measure name showed direct install smart thermostat with programmable baseline in climate zone 2
Smart Thermostat (Programmable Baseline)	PRJ-757666, PRJ-776696	2	Ex ante savings assumed basic programmable thermostat per unit savings for installed thermostat, but tracking data measure name showed a smart thermostat.
Smart Thermostat (Manual Baseline)	PRJ-1005543, PRJ-1008467 and PRJ-1008480, plus others	16	Ex ante savings assume multi-family homes despite Residential building type field indicating "Single Family". Navigant recommendation for GPY6 is to use single family assumptions.
Smart Thermostat (Manual Baseline)	PRJ-823566	1	Ex ante savings assumed basic programmable thermostat per unit savings for installed thermostat, but tracking data measure name showed a smart thermostat with a manual baseline.
Smart Thermostat (Manual Baseline)	EA-0000594281, PRJ-1466303, PRJ-1576364, plus others	8	Ex ante savings assume programmable baseline but tracking data measure name showed a manual baseline

Source: Nicor Gas tracking data and Navigant team analysis.

In Section 5.3.11 Programmable Thermostats and Section 5.3.16 Advanced Thermostats, the IL TRM indicates that "installation of multiple programmable thermostats per home does not accrue additional savings." Therefore, Navigant capped the quantity of thermostats at one per project for single family (SF) homes and reduced the quantity from two to one for four programmable thermostat projects.

In less than one percent of programmable thermostat projects, the implementer calculated ex ante savings using inputs from a different climate zone than the site's climate zone.

In eight percent of smart thermostat (manual baseline) projects, the implementer calculated ex ante savings with inputs assuming a multifamily home despite the residential building type indicating "Single Family." Navigant calculated verified savings using single family inputs for these projects.

In nine percent of all smart thermostat measures, the implementer calculated ex ante savings with inputs assuming a different type of thermostat installed or baseline thermostat than described in tracking data. For example, in some cases ex ante savings assumed a manual baseline but tracking data showed a programmable thermostat. In other cases, ex ante savings assumed a basic programmable baseline but tracking data showed a manual baseline, or, ex ante savings assumed installation of a basic programmable thermostat but tracking data showed a smart thermostat.

The implementer has informed Navigant they have corrected these issues with programmable and smart thermostats for future program years but did not make any corrections retrospectively.

Recommendation 5. Navigant recommends the implementer make the following corrections when calculating savings for thermostats: (1) cap savings of thermostats at one per project for single family homes, (2) use assumptions for the site's correct climate zone, (3) use SF assumptions for residential building types that are designated as SF, and (4) use assumptions for the correct installed thermostat (whether smart or basic programmable thermostat) and baseline thermostat.

6. APPENDIX 1. IMPACT ANALYSIS METHODOLOGY

Navigant followed algorithms outlined in the IL TRM v5.0 to calculate verified gross savings for the HES Program. The evaluation team verified that these algorithms and appropriate deemed input parameters were correctly applied and validated custom parameters that were used. Navigant calculated verified net savings by multiplying verified gross savings by a NTGR of 1.05. The IL SAG reviewed and deemed the NTGR value for the HES Program.

7. APPENDIX 2. TOTAL RESOURCE COST DETAIL

Table 7-1, the Total Resource Cost (TRC) variable table, only includes cost-effectiveness analysis inputs available at the time of finalizing the PY6 HES impact evaluation report. Additional required cost data (e.g., measure costs, program level incentive and non-incentive costs) are not included in this table and will be provided to the evaluation later. Detail in this table (e.g., EULs), other than final PY6 savings and program data, are subject to change and are not final.

Table 7-1. Total Resource Cost Savings Summary for Nicor Gas

Measure	Units	Quantity	Effective Useful Life	Ex Ante Gross Savings (Therms)	Verified Gross Savings (Therms)	Verified Net Savings (Therms)
Air Sealing	Home	1,245	15	127,371	127,243	133,605
Attic Insulation	Square Feet	1,547,560	25	100,445	100,663	105,696
Basement/Sidewall Insulation	Square Feet	21,549	25	3,437	3,746	3,934
Bathroom Aerator	Each	8,589	9	5,926	5,926	6,223
Duct Sealing	Home	29	20	14,077	13,462	14,135
HW Pipe Insulation	Linear Feet	9,009	15	9,549	9,522	9,998
Kitchen Aerator	Each	1,665	9	9,324	9,324	9,790
Programmable Thermostat	Each	1,138	5	71,336	71,098	74,653
Showerhead	Each	8,186	10	114,931	114,959	120,707
Smart Thermostat (Manual Baseline)	Each	210	10	17,814	18,593	18,593
Smart Thermostat (Programmable Baseline)	Each	813	10	46,681	45,795	45,795
Smart Thermostat (Unknown Baseline)	Each	31	10	2,305	2,305	2,305
Thermostat Education	Each	943	2	58,758	58,758	61,696
Wall Insulation	Square Feet	73,452	25	7,810	7,810	8,201
Water Heater Setback	Each	1,296	2	4,536	4,532	4,758
Total/Weighted Average		1,675,715	13	594,302	593,738	620,090

Source: Nicor Gas tracking data and Navigant team analysis.